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# The Pricing of Retail Deposits: Concentration and Information*

LINDA ALLEN

*Baruch College, New York, New York 10010*

AND

ANTHONY SAUNDERS AND GREGORY F. UDELL

*Stern School of Business, New York University, New York, New York 10006*

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The traditional structure–conduct–performance (SCP) hypothesis relates concentration and the mean level of prices but ignores the dispersion of prices around their mean levels. This paper tests two hypotheses which are capable of explaining both the mean and the dispersion of elements in the pricing vector of retail banks—a concentration/collusion-based hypothesis and an asymmetric information-based hypothesis. Evidence is found that the dispersion of bank fees across banks may be due to *both* market structure and information reasons. The level of bank fees appears to be generally insignificantly related to concentration. 

## I. INTRODUCTION

This paper examines empirically the relationship between the prices of bank services and: (i) concentration among banks in a given market and (ii) (possibly unobservable) customer heterogeneity in that market. The analysis is motivated by two strands of contemporary banking theory: the

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structure–conduct–performance (SCP) hypothesis and the asymmetric information hypothesis.

The SCP hypothesis views the banking industry as imperfectly competitive and asserts that the price in any banking market is related to the structure of the market. Specifically, the greater the concentration in the market for a given product, the larger the potential for price collusion among banks and the higher the average price in that market. This theme, which has been the subject of the empirical literature on the relationship between market structure and bank performance (e.g., Berger and Hannan (1989) and Gilbert's (1984) survey), focuses on the mean of prices (or profits) without specifically addressing the price dispersion. Data on bank pricing suggest, however, that fees and rates on retail banking services may vary considerably within a given banking market. Moreover, price dispersion does not appear to be constant across geographic markets. A unified theory of bank pricing therefore should explain price dispersion as well as the average price. To address the relationship between concentration and price dispersion, we rely on recent work by Hannan (1991), which extends the SCP paradigm. Under the expanded SCP hypothesis, Hannan derives a negative relationship between concentration and price dispersion.

In recent years a new theory of deposit pricing has been developed based on information asymmetries among contracting parties (see Shaffer, 1984; Udell, 1986). The basic idea is that deposit fees and interest rates can be used by banks to sort customers of different quality types. Two fees often identified as potentially being able to sort depositors are (i) the fee for insufficient funds in a deposit account (NSF fee) and (ii) the minimum balance required to waive service charges (MBD).

Unlike the SCP view of bank pricing, which focuses on banks as suppliers of services, the information/sorting approach focuses on the demand (customer) side of the market. That is, privately informed customers can transmit information to the bank through the demand schedules they submit for different bank services. Specifically, customers differ with respect to the probability of default on bank deposits as well as loans, and these differences may not be observable to the bank. Consequently, a sorting mechanism by which banks could price each quality group would be useful. This sorting mechanism should be incentive compatible in that the demand for products designed by the bank for a particular risk class should only come from customers in that risk class.

We develop a simple model of asymmetric information and show that in a separating Bayesian Perfect Nash equilibrium, the greater the underlying unobservable heterogeneity in payoff-relevant customer attributes, the greater the dispersion of equilibrium interest rates and fees, and also the greater the level of at least some equilibrium rates and fees. Thus, the asymmetric information hypothesis implies a positive relationship between price dispersion and customer heterogeneity. Moreover, the asymmetric information hypothesis implies a positive relationship between the mean level and customer heterogeneity for some fees and an offsetting negative relationship for others.

We then test the implications of the expanded SCP hypothesis and the asymmetric information hypothesis. Our empirical task is hampered somewhat by the absence of an integrated model that studies price dispersion in an oligopolistic market under asymmetric information. The expanded SCP model assumes symmetric information, whereas the asymmetric information model assumes that banking markets are competitive.[1] However, as long as bank market structure itself is not significantly influenced by the degree of unobservable customer heterogeneity in that market,[2] these two hypotheses can be viewed as pointing to different (and unrelated) sources of price dispersion. Thus we can ask whether customer heterogeneity can explain price dispersion beyond that explained by bank concentration.

The rest of the paper is organized as follows. Section II describes the expanded SCP hypothesis, develops an illustrative asymmetric information model, and derives the testable implications of these models. Section III describes the empirical tests. Section IV discusses the results and Section V concludes.

## II. THE THEORY AND TESTABLE IMPLICATIONS

### A. *The Expanded SCP Hypothesis*

In an imperfectly competitive banking industry, there may be price interdependence among market participants. Waterson (1984) has captured the nature of the interdependence in pricing behavior with his conjectural variation measure $\alpha_{ik}(= dp_k/dp_i)$, where $p_i$ is firm $i$'s price and conjectural variation represents "firm $i$'s belief about the effect of its price change on $k$'s behavior (p. 27)."[3] If, as in Hannan (1991), firm $i$'s weighted average conjectural variation $\alpha_i$ ($\alpha_{ik}$ weighted over all other firms, i.e., $k \neq i$) is a positive function of market concentration, then in high concentration markets the $\alpha_i$'s will be close to one and in low concentration markets the $\alpha_i$'s will be close to zero. Thus, in a highly concen-

[1] Recently, Besanko and Thakor (1991) have developed a spatial model of banking in which banks function in an oligopoly and there is asymmetric information. However, their model addresses a different set of issues from those that concern us here.

[2] This question has never been raised in the literature, but may constitute an interesting empirical issue to examine in the future, since it is possible that the attributes of potential customers in a given market may affect a bank's decision to enter the market. Moreover, private information about customers may be a source of market power.

[3] Waterson's analysis follows Cubbin (1974).

trated market, each firm will view its own demand elasticity as the market demand elasticity. That is (from Hannan, 1991, Eq. (8)), the elasticity of demand for bank $i$ in the market for product $j$ is

$$e_{ij} = [1 - \alpha_{ij}(\mathrm{CR}_j)]\eta_{ij} + \alpha_{ij}(\mathrm{CR}_j)\eta_{Ij}, \tag{1}$$

where

$\alpha_{ij}(\mathrm{CR}_j)$ is the weighted average conjectural variation for bank $i$ as a function of market concentration $\mathrm{CR}_j$ for the $j$th product with $\alpha'_{ij}(\mathrm{CR}_j) > 0$ and $0 \leq \alpha_{ij} \leq 1$;

$\eta_{ij}$ is the absolute value of the elasticity of demand for bank $i$ if rivals do not match bank $i$'s price change; and

$\eta_{Ij}$ is the absolute value of the elasticity of demand for bank $i$ if rivals completely match bank $i$'s price change where $\eta_{ij} > \eta_{Ij}$.

Equation (1) implies that each firm will view its own demand elasticity as the market demand elasticity in highly concentrated markets (i.e., markets in which $\alpha_{ij}(\mathrm{CR}_j) = 1$). If all banks face the same cost as $c_j$, then prices will converge as concentration increases. When $\alpha_{ij}(\mathrm{CR}_j) = 1$, the market will be characterized by a single price $P_j$, where $P_j = c_j[\eta_{Ij}/(\eta_{Ij} - 1)]$. When $\alpha_{ij} = 0$, price dispersion will be the greatest as each bank's price will depend only on an idiosyncratic elasticity $\eta_{ij}$ $(= e_{ij})$ which will vary across banks. Consequently, this expanded SCP view implies a negative relationship between concentration and price dispersion (or $d\sigma_j/d\mathrm{CR}_j < 0$).

It should be noted that the Hannan model assumes imperfect or monopolistic competition in the banking market. For example, in each banking market firms differ by their spatial or geographic location. However, if this market is fully (perfectly) competitive, and there are no spatial (or other) differences among banks, then conjectural variation is zero and so is price dispersion. Thus the prediction of a negative relationship between price dispersion and conjectural variation (concentration) depends on some type of product differentiation in the market. In the absence of such product differentiation the relationship between price dispersion and concentration might tend to look like an inverted U, with zero price dispersion at perfect competition (no concentration) and zero again at some very high level of concentration where all firms collude. (If information is asymmetric, price dispersion may be found even if the market is perfectly competitive or the bank is a monopolist.) In the empirical section, a sensitivity test is conducted to examine the robustness of the Hannan model prediction that $d\sigma_j/d\mathrm{CR}_j < 0$ versus the alternative U-shaped prediction that over some range of low market concentration $d\sigma_j/d\mathrm{CR}_j > 0$, and only over a high range of market concentration is $d\sigma_j/d\mathrm{CR}_j < 0$.

### B. *The Asymmetric Information Model*[4]

Consider a universally risk neutral banking market in which retail customers purchase two services from banks, a checking account and a one-period loan. For simplicity, assume that bank customers must purchase both services from the same bank. Customers borrow $L > 0$ at the beginning of the period and with probability $q \in (0, 1)$ they default on their loans at the end of the period. If there is default, the borrower has only an amount $w > 0$ available to repay its loan. Let $w < R_f L$, where $R_f$ is one plus the riskless interest rate.

Suppose there are two types of borrowers: high and low quality. Each knows its own type ("$h$" for high quality and "$l$" for low quality) but no one else does. Let the endowment $w$ be $w_i$ for borrower $i \in \{h, l\}$, with $R_f L > w_h > w_l > 0$. Define $r_i$ as the loan interest rate factor (one plus the loan interest rate) that the bank charges a borrower that reveals itself to be type $i \in \{h, l\}$.

Banks also offer checking accounts and incur a cost, $c > 0$, for processing checks returned for "not sufficient funds" (NSF).

Suppose a type $i$ borrower overdraws its deposit account with probability (w.p.) $\beta_i \in (0, 1)$. We assume that this probability is lower for the higher quality borrower, so that $1 > \beta_l > \beta_h > 0$. Let $n$ be the NSF fee charged to a customer for overdrawing its account. Then the bank is assumed to incur a cost $\gamma(n - c)$ with $\gamma > 0$, whenever its fee $n$ deviates from its marginal cost $c$. Banks are assumed to be perfectly competitive and earn zero profits.

The assumption of marginal cost pricing in the absence of asymmetric information is restrictive but does not affect the model's results. In particular, if each customer has the same constant elasticity of demand, the bank will charge the same proportional markup over marginal cost. The departure from first-best pricing could then be in terms of the departure from this fixed markup.

The benchmark first-best solution, involving common knowledge of each borrower's $w$ and $\beta$, is straightforward. The bank's profit on each type $i$, $\Pi_i$, is zero in equilibrium, which yields

$$\Pi_i = [1 - q]r_i L + q w_i + [1 - q]\beta_i[\{n_i - c\} - \gamma\{n_i - c\}] - R_f L = 0. \quad (2)$$

Pareto-efficient (first-best) contracts satisfying (2) are characterized by

$$n_i^0 = c \quad (3)$$

[4] The model developed below is based on Udell (1986).

$$r_l^0 = R_f[1 - q]^{-1} - q[1 - q]^{-1}w_iL^{-1} \tag{4}$$

for $i \in \{h, l\}$.

Under asymmetric information, we can think of a simple game in which the informed borrower moves first and asks to borrow at a particular interest rate. The uninformed bank responds by updating its priors about the borrower's type, using Bayes' rule whenever possible, and then awarding the borrower a particular NSF fee.[5] The equilibrium concept we use is the Bayesian Perfect Nash equilibrium.[6] In a competitive Bayesian Perfect Nash equilibrium, banks will compete to offer borrowers the best possible contracts. Let $\psi_i = \{r_i^*, n_i^*\}$ be the contract awarded in equilibrium to the type $i$ borrower. We can now prove the following.

PROPOSITION 1. *The following is a competitive Bayesian Perfect Nash equilibrium.*[7] *The low quality borrower asks for an interest factor*

$$r_l^* = R_f[1 - q]^{-1} - q[1 - q]^{-1}w_lL^{-1} \tag{5}$$

*and is awarded a contract* $\psi_l = \{r_l^*, n_l^*\}$, *where* $n_l^* = c$, *with the bank believing with probability one that the borrower is low quality. The high quality borrower asks for an interest factor*

$$r_h^* = \{R_fL - qw_h - q\beta_h(1 - \gamma)(w_h - w_l)[\beta_l - \beta_h(1 - \gamma)]^{-1}\}[(1 - q)L]^{-1} \tag{6}$$

*and is awarded a contract* $\psi_h = \{r_h^*, n_h^*\}$, *with the bank believing with probability one that the borrower is high quality, where*

$$n_h^* = q[1 - q]^{-1}[w_h - w_l][\beta_l - \beta_h(1 - \gamma)]^{-1} + c > n_h^0. \tag{7}$$

*If the borrower asks for a nonequilibrium interest factor* $r \notin \{r_l^*, r_h^*\}$, *the bank believes with probability one that the borrower is of low quality and awards a contract at that interest factor which has an NSF fee n that yields the bank zero profit, conditional on that belief. Moreover,* $\partial(n_h^* - n_l^*)/\partial(w_h - w_l) > 0$.

*Proof.* See Appendix.

[5] Alternatively, we could view the borrower as asking for a particular NSF fee, and the bank responding with a loan interest rate. The results would not change.

[6] The equilibrium also can be described as sequential in the sense of Kreps and Wilson (1982). Further, we could have modeled this as a game in which the uninformed bank moves first and employed a Riley (1979) reactive equilibrium. The results would be essentially the same.

[7] This Bayesian Perfect Nash equilibrium is not unique. However, we conjecture that the equilibrium given below survives refinements such as the Cho–Kreps (1987) intuitive criterion.

This Bayesian Perfect Nash equilibrium is intuitive. Note that $r_l^* > r_h^*$ and $n_l^* < n_h^*$. Since the low quality borrower has a lower repayment probability, it is willing to pay a higher interest rate than a high quality borrower. Similarly, since the low quality borrower has a higher probability of overdrawing its deposit account, it is more averse to the NSF fee than the high quality borrower. Thus, the equilibrium NSF fee is higher for the high quality borrower.

This proposition also asserts that the dispersion in the NSF fees increases as the difference between $w_h$ and $w_l$ increases. Holding $\beta_h$ and $\beta_l$ fixed, an increase in $w_h - w_l$ means that the disparity in the innate attributes of high and low quality borrowers has increased. Thus, greater customer heterogeneity results in greater fee and rate dispersion. Another implication of this proposition is that the mean level of NSF fees will be higher and the mean interest rate factor lower under asymmetric information than under symmetric information. This is because $n_l^* = n_l^0$ and $n_h^* > n_h^0$; and $r_l^* = r_l^0$ and $r_h^* < r_h^0$. Moreover, it follows that as the heterogeneity in customer types increases, the mean NSF fee will increase and the mean interest rate factor will decrease.[8]

## C. *Empirical Implications*

The implication of the previous two subsections is that the dispersion of interest rates and fees across banks is negatively related to the concentration in a banking market (the expanded SCP hypothesis) and that the dispersion of rates and fees is positively related to the dispersion among quality types in that market. These hypotheses can be specified in testable form as[9]

$$\sigma_j = f(\underset{-}{\mathrm{CONC}_j}, \underset{+}{\mathrm{INF}_j}), \tag{8}$$

[8] For simplicity, in our formal model, we have considered only loan interest rates and NSF fees as sorting devices. However, other elements in the pricing menu may be used as screening devices. For example, in Udell (1986) banks incur default risk on checking accounts because of the possibility that a depositor who has drawn on a "bad-funds" deposit may not be able to replace the bad-funds deposit with good funds. Sorting is achieved by using the NSF fee and the monthly maintenance fee (the MMF) in a manner analogous to the NSF fee and the interest rate in our model. Alternatively, a minimum opening balance or a minimum deposit balance for a fee waiver may be a substitute for the NSF fee. If low quality borrowers are more liquidity-constrained than high quality borrowers, then the costs associated with meeting a minimum balance requirement may be higher for low quality customers, just as the expected costs of a high NSF fee may be higher for low quality customers.

[9] The key to the estimation equation given below is that the independent variables are uncorrelated. Empirically, the correlations between $\mathrm{CONC}_j$ (as measured by a statewide Herfindahl Index (HHI) and $\mathrm{INF}_j$ (as measured by the standard deviation of state income (INCSTD), the weighted average delinquency rate of loans outstanding (WAVG), the personal loan delinquency rate (PERS), the direct auto loan delinquency rate (AUTD), home appliance delinquency rate (HOME), and the revolving credit delinquency rate (REVC) are all insignificantly different from zero at the 5% level.

where

$\sigma_j$ is a measure of dispersion of fees or interest rates for the $j$th product;
$\text{CONC}_j$ is a measure of concentration ($\text{CR}_j$) in the $j$th market;
$\text{INF}_j$ is a measure of customer quality dispersion ($\phi_j$) in the $j$th market.

The above test might be contrasted with the traditional test of the SCP hypothesis which analyzes only the mean effective price level in any market ($\mu_j$) relative to concentration in that market ($\text{CR}_j$). The traditional SCP view posits a positive relationship among (mean) interest rate, or fees, and a measure of concentration ($\text{CONC}_j$) in the $j$th bank market. Fee dispersion is ignored. Here we test fee dispersion, as well as the mean level of fees. According to the SCP hypothesis, the mean fee level is increasing in concentration, while the asymmetric information hypothesis implies that the mean fee level is increasing in the underlying customer heterogeneity for the NSF fee and decreasing in the interest rate (APR) and MMF. Thus,

$$\mu_j = g(\underset{+}{\text{CONC}_j}, \underset{+\text{ or }-}{\text{INF}_j}), \tag{9}$$

where

$\mu_j$ is a measure of the mean fee (or interest rate) in the $j$th market.

## III. EMPIRICAL TESTS

Since both Eqs. (8) and (9) have the same independent variables, there is no difference between estimating the two-equation model by OLS or GLS (see Greene, 1990, p. 512). Consequently, OLS was used.[10]

Data on interest rates and fees charged by individual banks are not readily available, but selective price and fee data are published in *Pricing Bank Services and Loans 1984* (Sheshunoff and Co., Inc.). These data include survey information on 1983 fees and prices for 1635 anonymous banks classified by state. The data indicate the number of banks in each state with fees of a classified amount (e.g., the number of banks in Texas with NSF fees of: 0–$1.00, $1.01–$2.00, $2.01–$3.00, etc.). These data make it possible to estimate mean NSF fees and standard deviations in each state plus the District of Columbia.[11] In a similar fashion we can

[10] Tests of the distribution of regression residuals did not reject normality.

[11] The mean fees are not quantity weighted since the necessary data are not reported in the survey.

estimate the means and standard deviations of the MMF and the annual interest rate in each state. The annual percentage rate (APR) used here is that on a bank's 36-month auto loan.[12] The MMF used is the monthly maintenance fee on demand deposits.[13]

The statewide Herfindahl Index (HHI) for deposits calculated from bank Reports of Condition for 1983 is used to measure concentration.[14] To measure dispersion of customer wealth, $w_h - w_l$ in Eqs. (6) and (7), we use the (statewide) standard deviation of household income.[15] The 1980 Population census collected data by state, for the number of households in (10) different income classes. The standard deviation of each state's distribution of income (INCSTD) was calculated using the lower bound of each class.[16]

To measure dispersion of customer risk, $\beta_l - \beta_h$ in Eqs. (6) and (7), we use one of five statewide default experience statistics for consumer loans: the personal loan delinquency rate (PERS), the direct auto loan delinquency rate (AUTD), the home appliance loan delinquency rate (HOME), the revolving credit loan delinquency rate (REVC), and a weighted average of various consumer loan delinquency rates (WAVG).[17] Information on default rates comes from the American Bankers Association (ABA), which published *Delinquency Rates on Bank Installment Loans*, each quarter, containing statewide figures for default on different classes of

[12] Auto loans may be purchased from dealers rather than originated by the bank. However, the Sheshunoff questionnaire asks, "What APR did you charge on 36 month auto loans as of September 30, 1983?" We interpret this to refer to direct auto loans.

[13] Usable data on the minimum balance required to open a checking account were not available in the Sheshunoff survey.

[14] Although the metropolitan statistical areawide (MSA-wide) HHI would be desirable, the Sheshunoff pricing data are available only on a statewide basis. Later in the paper we adjust the statewide HHI by the number of MSAs within the state as part of a robustness check on the results (see Section IVC).

[15] Household income, as defined by the Bureau of the Census, is essentially the personal income of the "householder and all other persons 15 years old and over in the household."

[16] An alternative explanation for an empirically observed positive relationship between the *dispersion* in customer wealth and the *dispersion* in fees is that different wealth-associated clienteles engender different marginal costs. For example, auto loan rates may be higher in poor than in wealthy regions or marginal cost-priced monthly maintenance fees may be higher in identifiably wealthy regions because the quality of service is higher (we thank an anonymous referee for pointing this out). It is somewhat more difficult to make this argument with respect to the NSF fee. Moreover, it is not clear that the quality differences across checking accounts are great and, therefore, to the extent that banks "unbundle" their pricing, this effect may be small. Note too that wealth-driven noninformation *dispersion* in interest rates may be partially controlled for by including the state default rate.

[17] WAVG is an average of the delinquency rates on eight categories of consumer installment loans weighted by the seasonally adjusted number of loans. The eight categories are personal loans, direct auto loans, indirect purchased auto loans, home appliance loans, FHA Title 1 loans, property improvement loans, mobile home loans, and recreational vehicle loans.

consumer loans. The assumption is that greater heterogeneity in observable customer attributes implies greater heterogeneity in unobservable, payoff-relevant attributes.

The expanded SCP hypothesis implies that fee dispersion ($\sigma_j$) is *negatively* related to HHI for the *j*th service and that the mean fee level ($\mu$) is *positively* related to HHI. On the other hand, the information hypothesis suggests a *positive* relationship between $\sigma_j$ and customer quality dispersion (as measured by wealth dispersion INCSTD and the default rates PERS, AUTD, HOME, REVC, and WAVG) and a *positive* relationship between $\mu_j$ = NSF fee and customer quality dispersion and a negative relationship between $\mu_j$ = APR (and $\mu_j$ = MMF) and customer quality dispersion. Five regressions reflecting each of the delinquency rate variables were tested for each of the three bank services (NSF, MMF, and APR).[18]

## IV. EMPIRICAL RESULTS

Table I reports descriptive statistics. If the determinants of bank retail pricing were fully explained by the traditional SCP hypothesis then we should expect a positive relationship between statewide market concentration and the level of fees and a negative relationship between concentration and fee dispersion. Consistent with the SCP hypothesis, the correlation coefficients between statewide HHI and the statewide dispersion measures NSFSTD, MMFSTD, and APRSTD are respectively −0.54, −0.55, and −0.41; i.e., they are negative and statistically significant at the 5% level. However, for mean fees, the correlation coefficient between NSFAVE and HHI is the only one that is positive (0.30) and significant at the 5% level.

In the absence of any other pricing determinants we would expect a high correlation among the elements (i.e., means of fees by state) in the retail pricing vector. Specifically, the SCP hypothesis predicts that all fees would be high in highly concentrated markets and low in less concentrated markets. The correlation matrix for the statewide *means* of the three pricing elements (NSFAVE, MMFAVE, and APRAVE) is shown in Table II. In general, only the correlation between NSFAVE and MMFAVE is significantly positive while the other two correlations are negative. Indeed, the negative correlation between NSFAVE and

[18] As noted earlier, the SCP hypothesis and the information hypothesis are not mutually exclusive. A given market might be characterized by both collusion-driven pricing and information-based customer heterogeneity. In the extreme case a monopolistic bank would be forced to offer multiple contracts (i.e., the sorting must be accomplished within the bank rather than across different banks by offering a separate contract to attract a different customer class).

TABLE I
VARIABLES AND THEIR SAMPLE MEANS

| Dependent variables | | Sample means |
|---|---|---|
| NSFAVE | Mean level of not sufficient funds fees for each state.[a] | \$9.80 |
| MMFAVE | Mean level of the monthly maintenance fees for each state.[b] | \$2.41 |
| APRAVE | Mean APR on a 36-month auto loan for each state.[c] | 14.03% |
| NSFSTD | Standard deviation of not sufficient funds fees for each state. | \$2.44 |
| MMFSTD | Standard deviation of monthly maintenance fees for each state. | \$1.18 |
| APRSTD | Standard deviation of the APR 36-month auto loan for each state. | 0.99% |
| **Exogenous variables** | | |
| INCSTD | Standard deviation of state income. Proxy for $w_h - w_l$. | \$12,030.95 |
| PERS | Personal loan delinquency rate (as % of loans outstanding). Proxy for $\beta_l - \beta_h$. | 2.83 |
| AUTD | Direct auto loan delinquency rate (as % of loans outstanding). Proxy for $\beta_l - \beta_h$. | 1.97 |
| HOME | Home appliance loan delinquency rate (as % of loans outstanding). Proxy for $\beta_l - \beta_h$. | 2.95 |
| REVC | Revolving credit loan delinquency rate (as % of loans outstanding). Proxy for $\beta_l - \beta_h$. | 1.97 |
| WAVG | Weighted average delinquency rate (as % of loans outstanding). Proxy for $\beta_l - \beta_h$. | 2.23 |
| HHI | Statewide Herfindahl Index (times 10,000). | 812.53 |
| **Control variables** | | |
| DMSA | Reciprocal of the number of MSAs per state. | 0.30 |
| UNIT | Dummy variable for unit banking state. | 0.18 |
| LIMIT | Dummy variable for limit branch banking. | 0.39 |
| RESP | Survey response rate. Number of banks responding to each survey question divided by total number of banks per state averaged over all states. | 0.06–0.12 |
| PACT | Dummy for interstate banking pacts. Equals 1 if pact passed during or before 1983. | 0.18 |
| POP | Dummy variable for population density. Equals 1 if state population density is below the nationwide median. | 0.49 |

[a] Number of respondent banks reporting their NSF fees: 1604 (Mean RESP = 0.12).

[b] Number of respondent banks reporting monthly maintenance fees: 750 (Mean RESP = 0.06).

[c] Number of respondent banks reporting their APR on their 36-month auto loans: 1556 (Mean RESP = 0.12) where RESP is the survey response rate.

TABLE II
CORRELATION OF STATEWIDE MEANS OF RETAIL PRICING ELEMENTS

| | NSFAVE | MMFAVE | APRAVE |
|---|---|---|---|
| NSFAVE | 1.00 | 0.45 | −0.19 |
| MMFAVE | | 1.00 | −0.13 |
| APRAVE | | | 1.00 |

*Note*. NSFAVE is the mean level of not sufficient funds fees for each state. MMFAVE is the mean level of the monthly maintenance fees for each state. APRAVE is the mean APR on a 36-month auto loan for each state.

APRAVE is consistent with the asymmetric information rather than with the SCP hypothesis since banks would offer lower loan rates and increased NSF fees in order to sort disparate customers. Therefore, the correlation matrix suggests that fees *do not* move together and that pricing may be more complicated than suggested by the traditional SCP hypothesis. In the remainder of this section we test the hypotheses embedded in Eqs. (8) and (9).

### A. *The Relationship among Fee Dispersion, Concentration, and Information*

*1. Tests of the Expanded SCP Hypothesis.* Table III shows the regression tests for the statewide variation or dispersion in fees or rates ($\sigma_j$). These support the expanded SCP hypothesis. Specifically, in all 15 regressions the HHI coefficients are significant with the expected *negative* sign.[19] Moreover, joint tests of significance fail to reject the hypothesis that the HHI coefficients are significantly negative for NSFSTD, MMFSTD, and APRSTD.[20]

*2. Tests of the Asymmetric Information Hypothesis.* Table III also offers support for the asymmetric information hypothesis. The information variable INCSTD has the expected *positive* sign in all 15 regressions, although coefficients are significant in only two of the five interest rate APR regressions. Joint tests fail to reject the hypothesis that the coefficient on INCSTD is significantly positive for the APRSTD system of regressions, although the same hypothesis is rejected for the NSFSTD and MMFSTD regressions.

The other information variable, the loan delinquency rate, is statistically significant in explaining the dispersion of the MMF (the coefficients

[19] All significance levels reported in Section IV are at the 5% level or better. Actual significance levels (and $t$ statistics) are reported in Tables III–VI.

[20] The joint tests referred to throughout this section were conducted using a $t^2$ test across regression equations. See Morrison (1967).

TABLE III

SUMMARY OF REGRESSION RESULTS FOR THE MODEL: Standard Deviation of Bank Service Price$_i$ = $\alpha_i + \beta_i$(INCSTD) + $\gamma_i$(Default Risk Measure) + $\delta_i$(HHI) + $\varepsilon_i$

The Bank Service Prices by state $i$ are: Not Sufficient Funds (NSF) fees, Monthly Maintenance Fees (MMF), and Auto Loan Rates (APR). INCSTD is the statewide standard deviation of income. The five alternative default risk measures are delinquency rates on: WAVG (weighted average of loan types), PERS (personal loan), AUTD (auto loan), HOME (home appliance loan), REVC (revolving credit loan). HHI is the Statewide Herfindahl Index for 1983.

| Intercept | INCSTD | Default risk | HHI | $R^2$ | Degrees of freedom |
|---|---|---|---|---|---|
| | | Dependent variable: NSFSTD | | | |
| | | WAVG | | | |
| 2.12 | 0.86 | −0.01 | −8.35*** | 0.32 | 48 |
| (0.88) | (0.42) | (−0.06) | (−4.57) | | |
| | | PERS | | | |
| 2.11 | 0.83 | 0.41E-2 | −8.35*** | 0.32 | 48 |
| (0.88) | (0.41) | (0.03) | (−4.54) | | |
| | | AUTD | | | |
| 2.42 | 0.74 | −0.09 | −8.41*** | 0.33 | 48 |
| (0.98) | (0.36) | (−0.49) | (−4.61) | | |
| | | HOME | | | |
| −2.07 | 3.83 | 0.18 | −7.50*** | 0.40 | 42 |
| (−0.87) | (1.91) | (1.45) | (−4.38) | | |
| | | REVC | | | |
| 2.22 | 0.75 | 0.11E-2 | −7.91*** | 0.24 | 42 |
| (0.81) | (0.34) | (0.01) | (−3.50) | | |
| | | Dependent variable: MMFSTD | | | |
| | | WAVG | | | |
| 0.65 | 0.34 | 0.22* | −4.94*** | 0.36 | 46 |
| (0.52) | (0.32) | (1.92) | (−4.46) | | |
| | | PERS | | | |
| 1.02 | 0.01 | 0.19** | −5.37*** | 0.39 | 46 |
| (0.84) | (0.01) | (2.35) | (−4.89) | | |
| | | AUTD | | | |
| 0.29 | 0.72 | 0.18* | −4.70*** | 0.36 | 46 |
| (0.23) | (0.68) | (1.83) | (−4.18) | | |
| | | HOME | | | |
| −1.42 | 2.37** | 0.04 | −5.45*** | 0.46 | 40 |
| (−1.21) | (2.39) | (0.63) | (−5.34) | | |
| | | REVC | | | |
| −0.21 | 1.12 | 0.21** | −5.93*** | 0.46 | 41 |
| (−0.17) | (1.05) | (2.60) | (−5.09) | | |
| | | Dependent variable: APRSTD | | | |
| | | WAVG | | | |
| −0.16 | 1.24* | −0.07 | −2.12*** | 0.23 | 48 |
| (−0.19) | (1.81) | (−0.94) | (−3.47) | | |
| | | PERS | | | |
| −0.30 | 1.44** | −0.09* | −1.96*** | 0.27 | 48 |
| (−0.38) | (2.12) | (−1.81) | (−3.25) | | |
| | | AUTD | | | |
| −0.10 | 1.13 | −0.04 | −2.13*** | 0.22 | 48 |
| (−0.11) | (1.64) | (−0.64) | (−3.46) | | |
| | | HOME | | | |
| −0.87 | 1.71** | 0.01 | −1.87*** | 0.28 | 42 |
| (−1.09) | (2.53) | (0.12) | (−3.23) | | |
| | | REVC | | | |
| 0.18 | 0.79 | 0.03 | −2.03*** | 0.20 | 42 |
| (0.22) | (1.16) | (0.63) | (−2.97) | | |

*Note.* $t$ statistics in parentheses. The degrees of freedom vary because of incomplete fee or delinquency data for some states. INCSTD = INCSTD * 10,000.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

for PERS, AUTD, REVC, and WAVG are all significant at the 10% level in the MMF regressions). However, the loan delinquency rate coefficients are not generally significant in explaining the dispersion of NSF or APR with half of the coefficients wrongly signed.[21]

### *B. The Relationship among the Mean Level of Fees, Concentration, and Information*

*1. Tests of the Expanded SCP Hypothesis.* These results are shown in Table IV. Looking first at the relationship between $\mu$ and HHI, it can be seen that the coefficients are mostly positive (the hypothesized sign) although not generally significant. Specifically, in the NSF and APR regressions the HHI coefficients are positive and in the MMF regressions the HHI coefficients are negative. Joint tests reject any significant relationship between HHI and NSFAVE, MMFAVE, and APRAVE. The evidence suggests that, contrary to the SCP view, there is no direct effect of concentration and collusion on the average level of bank fees (a result found elsewhere by Smirlock (1985) for other bank services).[22]

*2. Tests of the Asymmetric Information Hypothesis.* From Proposition 1 we know that the information variables should have a positive effect on the *mean* level of NSF fees and a negative effect on APR and MMF. For INCSTD the coefficients are all positive and generally significant in the NSF and MMF regressions. The INCSTD coefficients are negative but insignificantly different from zero in the five APR regressions. Joint tests fail to reject the hypothesis of a significant positive relationship between INCSTD and NSFAVE, while joint test statistics are insignificant for the MMF and APR systems of equations. The customer default rates are generally insignificantly different from zero and the coefficients are of varying signs. In only one case is the default coefficient significant. Overall, then, the positive coefficients for INCSTD in the NSF regression provide weak support for the predictions of the asymmetric information model.

### *C. Robustness Test 1*

One potential problem with the tests in Tables III and IV is that there may be a tendency for the HHI to overstate (understate) the degree of

[21] INCSTD tends to be a better proxy for $(w_h - w_l)$ than the five default risk measures (WAVG, PERS, AUTD, HOME, REVC) are for $(\beta_h - \beta_l)$. This is because INCSTD is an (income) *dispersion* measure while the default risk proxies are *mean* default risk measures. Of course, all empirical proxies represent ex post measures rather than the ex ante variables specified in the theoretical model.

[22] Smirlock used bank profitability instead of prices (or fees) for the dependent variable because he was jointly testing the traditional SCP hypothesis and Demsetz's (1973, 1974) "efficient structure hypothesis" (using market share).

TABLE IV

SUMMARY OF REGRESSION RESULTS FOR THE MODEL: Mean Bank Service Price$_i$ = $\alpha_i$ + $\beta_i$(INCSTD) + $\gamma_i$(Default Risk Measure) + $\delta_i$(HHI) + $\varepsilon_i$

The Bank Service Prices by state *i* are: Not Sufficient Funds (NSF) fees, Monthly Maintenance Fees (MMF), and Auto Loan Rates (APR). INCSTD is the statewide standard deviation of income. The five alternative default risk measures are delinquency rates on: WAVG (weighted average of loan types), PERS (personal loan), AUTD (auto loan), HOME (home appliance loan), REVC (revolving credit loan). HHI is the Statewide Herfindahl Index for 1983.

| Intercept | INCSTD | Default risk | HHI | $R^2$ | Degrees of freedom |
|---|---|---|---|---|---|
| | | Dependent variable: NSFAVE | | | |
| | | WAVG | | | |
| −4.73 | 12.69*** | −0.51 | 6.82* | 0.25 | 48 |
| (−0.89) | (2.83) | (−1.08) | (1.69) | | |
| | | PERS | | | |
| −5.45 | 12.72*** | −0.17 | 7.26* | 0.23 | 48 |
| (−1.02) | (2.76) | (−0.49) | (1.77) | | |
| | | AUTD | | | |
| −4.34 | 11.89** | −0.29 | 6.77 | 0.24 | 48 |
| (−0.78) | (2.63) | (−0.69) | (1.67) | | |
| | | HOME | | | |
| 0.75 | 7.26* | −0.13 | 5.77 | 0.16 | 42 |
| (0.15) | (1.72) | (−0.48) | (1.59) | | |
| | | REVC | | | |
| −5.75 | 12.59** | 0.33E-2 | 6.92 | 0.22 | 42 |
| (−0.98) | (2.61) | (0.01) | (1.43) | | |
| | | Dependent variable: MMFAVE | | | |
| | | WAVG | | | |
| −1.45 | 3.02* | 0.16 | −1.89 | 0.09 | 46 |
| (−0.69) | (1.72) | (0.87) | (−1.03) | | |
| | | PERS | | | |
| −1.16 | 2.74 | 0.16 | −2.24 | 0.10 | 46 |
| (−0.56) | (1.54) | (1.16) | (−1.21) | | |
| | | AUTD | | | |
| −1.78 | 3.33* | 0.16 | −1.68 | 0.10 | 46 |
| (−0.83) | (1.89) | (0.95) | (−0.89) | | |
| | | HOME | | | |
| −0.81 | 3.03* | −0.07 | −3.50** | 0.15 | 40 |
| (−0.41) | (1.82) | (−0.70) | (−2.04) | | |
| | | REVC | | | |
| −2.79 | 4.03** | 0.24* | −2.17 | 0.16 | 41 |
| (−1.23) | (2.15) | (1.68) | (−1.07) | | |
| | | Dependent variable: APRAVE | | | |
| | | WAVG | | | |
| 13.96*** | −0.37 | 0.16 | 2.19 | 0.05 | 48 |
| (6.09) | (−0.19) | (0.77) | (1.27) | | |
| | | PERS | | | |
| 14.14*** | −0.20 | −0.01 | 2.16 | 0.03 | 48 |
| (6.16) | (−0.10) | (−0.07) | (1.23) | | |
| | | AUTD | | | |
| 13.22*** | 0.09 | 0.27 | 2.35 | 0.08 | 48 |
| (5.70) | (0.05) | (1.51) | (1.38) | | |
| | | HOME | | | |
| 14.05*** | 0.06 | −0.10 | 2.68 | 0.08 | 42 |
| (5.57) | (0.03) | (−0.76) | (1.48) | | |
| | | REVC | | | |
| 14.31*** | −0.49 | 0.10 | 1.33 | 0.02 | 42 |
| (5.54) | (−0.23) | (0.64) | (0.62) | | |

*Note.* *t* statistics in parentheses. The number of observations varies because of incomplete fee or delinquency data for some states. INCSTD = INCSTD * 10,000.

* Significance at the 10% level.

** Significance at the 5% level.

*** Significance at the 1% level.

concentration in states with a small (large) number of banks because the relevant geographical market for the $j$th product is a smaller geographical area such as an MSA. If the relevant market is the MSA, the statewide HHI can be viewed as measuring interstate differences in concentration levels, while ignoring intrastate (market based) concentration. The greater (lesser) the number of MSAs within the state, the greater (lesser) the potential bias introduced by using statewide HHIs rather than MSA-adjusted HHI measures.[23] Therefore, low HHI values may be biased downward since a low statewide HHI may understate market concentration if the state contains many distinct, individually highly concentrated markets. To adjust for the noise in the statewide HHI measure, we introduced a dummy variable (DMSA) which is the reciprocal of the number of MSAs within each state. In the regressions reported in Tables V and VI, the measure of concentration is the adjusted statewide HHI (HHI * DMSA).

As further control variables, we also introduced measures of the competitiveness and regulatory restrictiveness of each statewide banking market. In states such as Texas and Illinois, for example, there are many unit banks. As a result, HHI in these states will ordinarily be small simply because there is a large number of small banks. In order to control for such effects, three additional variables were added to the regressions: a dummy variable (UNIT) if the state was a unit banking state, a dummy variable (LIMIT) if the state only permitted limited branch banking, and a dummy varible (PACT) which was set equal to one if the state had passed legislation permitting limited interstate banking (within the confines of a regional interstate banking pact) during 1983 or earlier and zero otherwise.

The two remaining control variables were RESP and POP. In 1983 there were more than 280 banks in each state on average. This compares to an average of fewer than 30 responses per state in the Sheshunoff survey. To examine the representativeness of statewide response to the survey, we also introduced a variable to reflect the bank response rate. The variable RESP was obtained by dividing the number of banks responding to the survey in each state by the total number of banks in that state as of 1983.[24] Finally, since the costs of servicing customers in low population density states (such as Wyoming) may be higher than the costs in high density states (such as New York), we utilized a dummy variable for state population density. The dummy variable POP was set equal to one if the state's population density was below the nationwide median (as of the 1980 Population Census) and zero otherwise.

[23] The statewide dispersion in prices (NSFSTD, MMFSTD, APRSTD) is positively correlated with the number of markets within each state (MSA). Moreover, MSA is negatively correlated with HHI, as expected.

[24] This variable was almost always insignificant.

*1. Robustness Test 1 and the Expanded SCP Hypothesis.* The results of these robustness tests are shown in Tables V and VI. In Table V, as in the basic model (Table III), the coefficients on the adjusted HHI measure are strongly negative and significant for all dispersion regressions, a result consistent with the expanded SCP hypothesis. Thus, the results of the augmented model in Table V as well as the basic model in Table III are consistent with predictions of the expanded SCP hypothesis.

The robustness test results on the mean fee levels (shown in Table VI) are more consistent with the traditional SCP hypothesis than were the results of Table IV. That is, for NSFAVE and APRAVE there is now a positive and significant relationship, as opposed to the generally insignificant relationships in Table IV, between concentration (as measured by the adjusted HHI) and the average fee levels and the APR. Specifically, joint tests on the NSFAVE and APRAVE regressions fail to reject the hypothesis that the relationships among concentration and the statewide average NSF fee level and the statewide average APR are positive. The relationship between adjusted HHI and MMFAVE continues to be negative and insignificant in the robustness tests.

*2. Robustness Test 1 and the Asymmetric Information Hypothesis.* The positive and mostly significant (9 of 15) signs on the INCSTD variable in the fee/price dispersion regressions (Table V) are consistent with the information asymmetry hypothesis. This variable, which was positive, but generally insignificant in the basic model (Table III), is now significantly positive for all regressions except NSFSTD. Thus, Table V offers results more consistent with the information hypothesis.

The other proxy for customer heterogeneity, the default risk measures (WAVG, PERS, AUTD, HOME, REVC), performs essentially the same in the robustness tests (Table V) as in the basic model (Table III). That is, consistent with the information hypothesis, default risk coefficients are positive in 10 of 15 regressions, although the relationship is significantly positive only for the MMFSTD system of regressions.

In the *mean* fee robustness tests (Table VI), the positive and significant relationships between INCSTD and NSFAVE are consistent with the information hypothesis, as they were in the basic model (Table IV). However, the positive and generally insignificant signs for the relationships between INCSTD and APRAVE and INCSTD and MMFAVE are not consistent with the information hypothesis which predicts negative relationships among these variables.

Finally, all default risk variables (WAVG, PERS, AUTD, HOME, REVC) remain insignificant and wrongly signed in 7 of 15 regressions. Overall, the evidence on average fee levels and their relationship to the information variables is essentially unchanged from the basic model.

*3. Robustness Test 1 and the Effects of the Other Control Variables.* Among control variables, PACT is significantly negative for NSFAVE

TABLE V

SUMMARY OF REGRESSION RESULTS FOR THE EXPANDED MODEL: Standard Deviation of Bank Service Price$_i$ = $\alpha_i + \beta_i$(INCSTD) + $\gamma_i$(Default Risk Measure) + $\delta_i$(HHI * DMSA) + $a$(LIMIT$_i$) + $b$(UNIT$_i$) + $c$(RESP$_i$) + $d$(PACT$_i$) + $e$(POP$_i$) + $\varepsilon_i$

The Bank Service Prices by state $i$ are: Not Sufficient Funds (NSF) fees, Monthly Maintenance Fees (MMF), and Auto Loan Rates (APR). INCSTD is the statewide standard deviation of income. The five alternative default risk measures are delinquency rates on: WAVG (weighted average of loan types), PERS (personal loan), AUTD (auto loan), HOME (home appliance loan), REVC (revolving credit loan). HHI is the Statewide Herfindahl Index for 1983. HHI is adjusted for the number of MSAs within the state (multiplied by DMSA = the reciprocal of the number of MSAs per state). Control variables are: UNIT (dummy variable for unit banking state), LIMIT (dummy variable for limited branch banking state), RESP (survey response rate), PACT (dummy variable for interstate banking pacts), and POP (dummy variable for population density).

| Incpt | INCSTD | Default | HHI * DMSA | LIMIT | UNIT | RESP | PACT | POP | $R^2$ | Dof |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dependent variable: NSFSTD | | | | | | |
| | | WAVG | | | | | | | | |
| 1.09 | 0.91 | 0.04 | −11.85*** | 0.50 | 0.35 | 3.15 | 0.26 | −0.27 | 0.51 | 48 |
| (0.39) | (0.41) | (0.21) | (−4.12) | (1.29) | (0.69) | (0.88) | (0.60) | (−0.72) | | |
| | | PERS | | | | | | | | |
| 1.16 | 0.83 | 0.05 | −11.97*** | 0.50 | 0.36 | 3.07 | 0.25 | −0.27 | 0.51 | 48 |
| (0.41) | (0.37) | (0.33) | (−4.11) | (1.33) | (0.71) | (0.88) | (0.59) | (−0.73) | | |
| | | AUTD | | | | | | | | |
| 1.06 | 0.99 | −0.04 | −11.73*** | 0.54 | 0.40 | 3.58 | 0.28 | −0.23 | 0.51 | 48 |
| (0.38) | (0.45) | (−0.20) | (−4.10) | (1.39) | (0.77) | (1.03) | (0.69) | (−0.60) | | |
| | | HOME | | | | | | | | |
| 0.24 | 1.66 | 0.16 | −7.52*** | 0.68** | 0.75* | −1.12 | 0.35 | −0.77** | 0.60 | 42 |
| (0.10) | (0.82) | (1.31) | (−2.62) | (2.01) | (1.67) | (−0.34) | (0.87) | (−2.26) | | |
| | | REVC | | | | | | | | |
| −0.51 | 2.39 | 0.05 | −13.26*** | 0.34 | −0.16 | 2.96 | 0.07 | 0.13 | 0.48 | 42 |
| (−0.16) | (0.96) | (0.28) | (−4.14) | (0.81) | (−0.26) | (0.79) | (0.17) | (0.30) | | |
| | | | | Dependent variable: MMFSTD | | | | | | |
| | | WAVG | | | | | | | | |
| −2.28* | 2.35** | 0.25** | −6.57*** | 0.21 | −0.00 | 1.24 | −0.49** | 0.47*** | 0.62 | 46 |
| (−1.77) | (2.23) | (2.47) | (−4.67) | (1.06) | (−0.01) | (0.52) | (−2.50) | (2.66) | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PERS | | | | | | | | |
| −2.01* | 2.02** | 0.24*** | −7.09*** | 0.23 | 0.03 | 1.14 | −0.50*** | 0.50*** | 0.67 | 46 |
| (−1.68) | (2.04) | (3.60) | (−5.35) | (1.32) | (0.13) | (0.52) | (−2.77) | (3.07) | | |
| | | AUTD | | | | | | | | |
| −2.38* | 2.63** | 0.11 | −6.03*** | 0.27 | 0.02 | 1.74 | −0.41** | 0.48** | 0.57 | 46 |
| (−1.74) | (2.37) | (1.14) | (−4.11) | (1.29) | (0.08) | (0.69) | (−2.01) | (2.54) | | |
| | | HOME | | | | | | | | |
| −3.28** | 3.27*** | 0.11* | −4.67*** | 0.41** | 0.29 | 0.30 | −0.43** | 0.33* | 0.62 | 40 |
| (−2.54) | (3.14) | (1.70) | (−3.37) | (2.24) | (1.22) | (0.13) | (−2.09) | (1.91) | | |
| | | REVC | | | | | | | | |
| −3.62*** | 3.52*** | 0.22*** | −7.09*** | 0.21 | −0.22 | 1.47 | −0.45** | 0.70*** | 0.66 | 41 |
| (−2.61) | (3.14) | (3.09) | (−4.89) | (1.04) | (−0.76) | (0.60) | (−2.25) | (3.38) | | |
| | | | | Dependent variable: APRSTD | | | | | | |
| | | WAVG | | | | | | | | |
| −1.02 | 1.62** | −0.10 | −3.09*** | 0.18 | 0.26 | 1.93 | 0.15 | 0.08 | 0.44 | 48 |
| (−1.09) | (2.15) | (−1.38) | (−3.20) | (1.39) | (1.53) | (1.65) | (1.03) | (0.63) | | |
| | | PERS | | | | | | | | |
| −1.17 | 1.79** | −0.10** | −2.86*** | 0.17 | 0.25 | 2.08* | 0.16 | 0.07 | 0.47 | 48 |
| (−1.27) | (2.41) | (−2.08) | (−3.01) | (1.39) | (1.52) | (1.85) | (1.15) | (0.60) | | |
| | | AUTD | | | | | | | | |
| −0.91 | 1.50** | −0.09 | −3.16*** | 0.18 | 0.28 | 1.80 | 0.11 | 0.10 | 0.44 | 48 |
| (−0.97) | (2.01) | (−1.35) | (−3.29) | (1.39) | (1.60) | (1.57) | (0.80) | (0.75) | | |
| | | HOME | | | | | | | | |
| −0.55 | 1.28 | −0.01 | −2.11* | 0.13 | 0.27 | 0.41 | 0.16 | −0.06 | 0.36 | 42 |
| (−0.56) | (1.64) | (−0.24) | (−1.92) | (1.01) | (1.54) | (0.33) | (1.06) | (−0.46) | | |
| | | REVC | | | | | | | | |
| −1.14 | 1.56** | 0.03 | −3.20*** | 0.20 | 0.10 | 1.40 | 0.07 | 0.20 | 0.47 | 42 |
| (−1.25) | (2.12) | (0.64) | (−3.37) | (1.63) | (0.54) | (1.29) | (0.55) | (1.51) | | |

*Note.* $t$ statistics in parentheses. The number of observations varies because of incomplete fee or delinquency data for some states. INCSTD = INCSTD * 10,000.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

TABLE VI

SUMMARY OF REGRESSION RESULTS FOR THE EXPANDED MODEL: Mean Bank Service Price$_i$ = $\alpha_i + \beta_i$(INCSTD) + $\gamma_i$(Default Risk Measure) + $\delta_i$(HHI * DMSA) + $a$(LIMIT$_i$) + $b$(UNIT$_i$) + $c$(RESP$_i$) + $d$(PACT$_i$) + $e$(POP$_i$) + $\varepsilon_i$

The Bank Service Prices by state $i$ are: Not Sufficient Funds (NSF) fees, Monthly Maintenance Fees (MMF), and Auto Loan Rates (APR). INCSTD is the statewide standard deviation of income. The five alternative default risk measures are delinquency rates on: WAVG (weighted average of loan types), PERS (personal loan), AUTD (auto loan), HOME (home appliance loan), REVC (revolving credit loan). HHI is the Statewide Herfindahl Index for 1983. HHI is adjusted for the number of MSAs within the state (multiplied by DMSA = the reciprocal of the number of MSAs per state). Control variables are: UNIT (dummy variable for unit banking state), LIMIT (dummy variable for limited branch banking state), RESP (survey response rate), PACT (dummy variable for interstate banking pacts), and POP (dummy variable for population density).

| Incpt | INCSTD | Default | HHI * DMSA | LIMIT | UNIT | RESP | PACT | POP | $R^2$ | Dof |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Dependent variable: NSFAVE | | | | | | |
| | | WAVG | | | | | | | | |
| 2.67 | 8.64* | −0.10 | 13.25** | −0.14 | −1.35 | −17.27** | −1.62* | −1.55* | 0.44 | 48 |
| (0.42) | (1.71) | (−0.21) | (2.05) | (−0.16) | (−1.17) | (−2.15) | (−1.70) | (−1.85) | | |
| | | PERS | | | | | | | | |
| 2.82 | 8.40* | 0.03 | 12.96** | −0.20 | −1.40 | −18.02** | −1.68* | −1.59* | 0.44 | 48 |
| (0.44) | (1.64) | (0.08) | (1.98) | (−0.24) | (−1.23) | (−2.29) | (−1.78) | (−1.94) | | |
| | | AUTD | | | | | | | | |
| 2.68 | 8.41* | 0.22 | 12.81** | −0.30 | −1.54 | −18.90** | −1.70* | −1.72** | 0.44 | 48 |
| (0.43) | (1.69) | (0.50) | (2.00) | (−0.35) | (−1.32) | (−2.42) | (−1.84) | (−2.01) | | |
| | | HOME | | | | | | | | |
| 3.25 | 6.98 | 0.05 | 3.83 | −0.55 | −1.42 | −7.67 | −1.88** | −1.29 | 0.32 | 42 |
| (0.55) | (1.49) | (0.17) | (0.57) | (−0.70) | (−1.35) | (−1.0) | (−2.01) | (−1.64) | | |
| | | REVC | | | | | | | | |
| 0.69 | 10.14* | 0.18 | 9.34 | −0.57 | −1.84 | −17.59** | −1.79* | −1.47 | 0.43 | 42 |
| (0.10) | (1.84) | (0.51) | (1.31) | (−0.61) | (−1.33) | (−2.09) | (−1.80) | (−1.47) | | |
| | | | | Dependent variable: MMFAVE | | | | | | |
| | | WAVG | | | | | | | | |
| −2.65 | 4.16** | 0.29 | −4.12 | −0.10 | −0.47 | −1.12 | −1.27*** | −0.08 | 0.35 | 46 |
| (−1.13) | (2.16) | (1.59) | (−1.60) | (−0.29) | (−1.01) | (−0.26) | (−3.55) | (−0.25) | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | PERS | | | | | | | | |
| −2.37 | 3.85** | 0.25* | −4.56* | −0.06 | −0.42 | −1.07 | −1.27*** | −0.04 | 0.37 | 46 |
| (−1.02) | (2.01) | (1.93) | (−1.77) | (−0.17) | (−0.93) | (−0.25) | (−3.62) | (−0.12) | | |
| | | AUTD | | | | | | | | |
| −2.86 | 4.51** | 0.20 | −3.63 | −0.07 | −0.50 | −0.86 | −1.18*** | −0.09 | 0.33 | 46 |
| (−1.19) | (2.31) | (1.17) | (−1.41) | (−0.20) | (−1.02) | (−0.19) | (3.30) | (−0.29) | | |
| | | HOME | | | | | | | | |
| −.59 | 2.85 | .03 | −5.11** | −0.01 | −0.11 | −2.52 | −0.78** | −0.28 | 0.35 | 40 |
| (−.26) | (1.57) | (0.26) | (−2.11) | (−0.02) | (−0.27) | (−0.62) | (−2.17) | (−0.92) | | |
| | | REVC | | | | | | | | |
| −4.20 | 5.52*** | 0.24* | −4.58 | −0.16 | −0.62 | −0.08 | −1.21*** | 0.08 | 0.38 | 41 |
| (−1.59) | (2.59) | (1.78) | (−1.66) | (−0.42) | (−1.12) | (−0.02) | (−3.18) | (0.20) | | |
| Dependent variable: APRAVE | | | | | | | | | | |
| | | WAVG | | | | | | | | |
| 8.79*** | 3.16* | −0.20 | 5.68** | 0.78** | 0.68 | 4.96* | 0.46 | 1.34*** | 0.49 | 48 |
| (3.86) | (1.72) | (−1.11) | (2.42) | (2.47) | (1.63) | (1.74) | (1.35) | (4.40) | | |
| | | PERS | | | | | | | | |
| 8.55*** | 3.42* | −0.18 | 6.03*** | 0.75** | 0.65 | 5.09* | 0.47 | 1.32*** | 0.50 | 48 |
| (3.77) | (1.86) | (−1.45) | (2.56) | (2.46) | (1.60) | (1.83) | (1.40) | (4.45) | | |
| | | AUTD | | | | | | | | |
| 8.99*** | 2.92 | −0.15 | 5.51** | 0.76** | 0.70 | 4.60 | 0.39 | 1.36*** | 0.48 | 48 |
| (3.94) | (1.60) | (−0.94) | (2.34) | (2.42) | (1.64) | (1.64) | (1.17) | (4.33) | | |
| | | HOME | | | | | | | | |
| 9.83*** | 2.61 | −0.12 | 6.83*** | 0.50* | 0.63 | 2.56 | 0.50 | 1.14*** | 0.59 | 42 |
| (4.52) | (1.49) | (−1.16) | (2.78) | (1.68) | (1.62) | (0.94) | (1.45) | (3.96) | | |
| | | REVC | | | | | | | | |
| 9.11*** | 2.52 | 0.02 | 5.18** | 0.91*** | 0.51 | 4.68 | 0.39 | 1.50*** | 0.55 | 42 |
| (3.80) | (1.30) | (0.18) | (2.07) | (2.75) | (1.06) | (1.64) | (1.13) | (4.27) | | |

*Note.* $t$ statistics in parentheses. The number of observations varies because of incomplete fee or delinquency data for some states. INCSTD = INCSTD * 10,000.
* Significance at the 10% level.
** Significance at the 5% level.
*** Significance at the 1% level.

and MMFAVE, as expected, although insignificant for APRAVE. That is, the relaxation of interstate banking restrictions is consistent with a reduction in statewide average fee levels as markets become more contestable. LIMIT, UNIT, POP, PACT, and RESP control variables are mostly insignificant for the dispersion regressions although the relationship between MMFSTD and PACT is negative and significant (Table V). In the mean fee regressions (Table VI), most LIMIT, UNIT, POP, and RESP coefficients are insignificant except for a positive and significant relationship between LIMIT and APRAVE, a significantly positive relationship between POP and MMFSTD, and a significantly positive relationship between POP and APRAVE. That is, higher loan rates are observed for limited branch banking states, and states with lower population densities also experience higher loan rates (perhaps, because of the greater costs of serving a dispersed population) and greater fee dispersion (MMFSTD).[25]

## D. *Robustness Test 2*

Another robustness issue concerns implicit assumptions of Hannan's (1991) regarding imperfect or monopolistic competition. That is, in each (state) banking market, firms differ according to their location. However, if the banking market were fully (perfectly) competitive, then the conjectural variation coefficient would be zero and so would market price dispersion. Thus, the prediction of a negative relationship between price dispersion and conjectural variation (concentration) requires imperfect competition. As discussed in Section IIA, in the absence of product differentiation, the relationship between price dispersion and concentration might look more like an inverted U, with zero price dispersion at perfect competition (no concentration) and zero again at some high level of concentration where all firms collude, rather than the monotonically negative relationship implied by Hannan's model.[26]

To test for this possibility, the sample was divided into two subsamples based on the HHI variables. Specifically, the 50 states plus Washington, D.C., were divided into the 25 with the lowest HHI ratios ("the low concentration group") and the 26 with the highest HHI ratios ("the high

[25] While LIMIT, UNIT, and PACT control for many regulatory aspects directly affecting the structure of banking in a state, a more indirect regulatory effect may arise if permitted organizational structures differentially affect pricing decisions. In particular, pricing policy in (multi) bank holding company banks may be centralized at the holding company level. If this were the case, price dispersion might be less in those states which permitted multibank holding companies in 1983. To account for this possibility, the regressions in Tables III–VI were also run with a dummy variable (equal to one) for states which prohibited multibank holding companies (and equal to zero otherwise). The results of this robustness check (not shown) were not qualitatively different from those reported in Tables III–VI and the MBHC dummy variable was uniformly insignificant at the 10% level of significance.

[26] This line of reasoning was suggested by a referee.

concentration group").[27] Equation (8) was then reestimated for each subgroup based on this partitioning.[28] If the expanded SCP model (i.e., the Hannan model) is correct, we should expect the HHI coefficients for both the low concentration group and the high concentration group to be negative. On the other hand, if the market is not characterized by product differentiation, then we would expect to see a significantly positive coefficient of the HHI variable in the $\sigma_{ij}$ regressions for the low concentration group and a significantly negative coefficient for that variable in the high concentration group. Although not conclusive, our results on this score (not shown) offer some support for the Hannan–SCP hypothesis relative to the U-shaped hypothesis. In 14 of 15 regressions for the low HHI concentration group, the coefficient is negative, although none are statistically significant.[29] For the high concentration group, the HHI coefficient is always negative and statistically significant except in the APRSTD regressions. Thus, while these results tend to reject a significantly positive slope for the $\sigma$–HHI relationship (over some range), they also imply that the negative slope is significant in banking markets that have relatively high concentration ratios.

## E. *Robustness Test 3*

In addition to the expanded SCP hypothesis and the information hypothesis, a third (and alternative) explanation for fee dispersion is possible. In highly concentrated markets, banks are more likely to price discriminate. However, the extent of price discrimination will likely depend on differences in price elasticities of demand which, in turn, will be related to income dispersion in that market.[30] This hypothesis can be tested

[27] Since banks in the low HHI subsample are more similarly sized than banks in the high HHI subsample, dividing the data in this fashion also allows us to indirectly test for bias in using unweighted rather than weighted means. That is, differences between unweighted and weighted means and standard deviations should be less in the lowest HHI subsample. While some differences were identified for the coefficients on HHI in the $\sigma_{ij}$ variable regressions (see text) substantive differences in the mean regressions were not readily apparent, suggesting that the use of weighted means, if they were available, would most probably leave the results largely unchanged.

[28] That is, the observations for the low concentration group were always drawn from the 25 lowest HHI subsample and the observations for the highest concentration group were always drawn from the 25 highest HHI subsample—regardless of the relative proportion of missing observations between the two subsamples for any given regression.

[29] The HHI coefficients were negative for all MMFSTD and APRSTD regressions and negative in 4 of 5 NSFSTD regressions.

[30] Low income individuals may have relatively low price elasticities of demand for any given bank's service because of the availability of few substitutes (hence, "lifeline banking") whereas high income individuals may have highly price elastic demand because of the availability (ease of switching) to other banks', or nonbanks'. Thus, the more dispersed the income levels, the greater the incentive for banks with oligopoly power to price discriminate.

by adding an interaction variable between INCSTD and HHI and testing for a positive coefficient on this interactive term. The results we obtained (not shown) from these tests indicate, however, that the coefficient on the interaction variable is uniformly insignificant and generally wrongly signed, while the information and expanded SCP results remain qualitatively unchanged.

## V. SUMMARY AND CONCLUSION

This paper has investigated two theories of price determination in retail banking markets. These theories produced different, although not mutually exclusive, predictions regarding the determination of both the dispersion and level of retail fees and prices. The structure–conduct–performance hypothesis argues that if markets are concentrated, banks will tend to collude. This is consistent with a low dispersion of fees and rates across banks in highly concentrated markets. In one equilibrium associated with the information hypothesis, banks will try to induce privately informed depositors to self-sort in order to solve these information problems. The more heterogeneous the depositors, the greater the incentive to sort by pricing elements and, *ceteris paribus,* the greater should be the variability or dispersion of fees and prices.

The data generally demonstrated a consistent negative relationship between fee dispersion and the statewide HHI, consistent with the expanded SCP hypothesis. The information variable INCSTD was also found to enter most fee dispersion equations. This suggests that the dispersion of fees across banks may be influenced by both market structure and information considerations.

The paper also tested the traditional SCP relationship which predicts a positive association between the mean price or fee levels and the degree of market concentration. Contrary to conventional wisdom, there was no strong evidence to support a positive relationship between concentration and the level of bank prices. However, this result may be partly attributable to our use of statewide rather than MSA-based measures of HHI. Including an MSA-adjusted HHI measure generally produced the expected positive sign between HHI and NSFAVE and HHI and APRAVE. The measure of customer income dispersion (INCSTD) was found to have a positive effect on the level of NSF fees, consistent with the prediction of our asymmetric information model, although, in general, the predicted negative effects for MMF and interest rates were not empirically supported.

## APPENDIX

*Proof of Proposition* 1. We first show that the posited equilibrium satisfies incentive compatibility. For the low quality borrower not to covet the high quality borrower's contract, we must have

$$r_l L + \beta_l n_l \leq r_h L + \beta_l n_h. \tag{A-1}$$

In a Bayesian Perfect Nash sequential equilibrium, contracts must minimize the borrower's expected costs subject to the bank's participation constraint and incentive compatibility. Thus, (A-1) will hold as an equality in equilibrium. Substituting the zero profit condition (1) into (A-1) for $r_h$ and substituting (3) into (A-1) for $r_l$, we get

$$n_h^* = q[1 - q]^{-1}[w_h - w_l][\beta_l - \beta_h(1 - \gamma)]^{-1} + c. \tag{A-2}$$

That is, the type $l$ borrower gets its first best expected cost, whereas $n_h^* > n_h^0 = c$ for the type $h$ borrower. Using (3) we can now use (A-2) to obtain

$$r_h^* = \{R_f L - q w_h - q\beta_h(1 - \gamma)(w_h - w_l)[\beta_l - \beta_h(1 - \gamma)]^{-1}\} [(1 - q)L]^{-1}. \tag{A-3}$$

Also, $n_l^* = c$ and

$$r_l^* = R_f[1 - q]^{-1} - q[1 - q]^{-1} w_l L^{-1}. \tag{A-4}$$

It is easy to verify that

$$r_h^* L + \beta_h n_h^* < r_l^* L + \beta_h n_l^*. \tag{A-5}$$

Given this, it is clear that if the borrower demands an interest factor of $r_l^*$, the bank must update its beliefs and believe with probability (w.p.) one that the borrower is low quality. It must offer such a borrower an NSF fee of $n_l^* = c$ since then the contract $\psi_l = \{r_l^*, n_l^*\}$ allows the bank to just break even. Similarly, if the borrower demands an interest factor of $r_h^*$, the bank must believe w.p. one that the borrower is high quality since that is the only Bayesian updating consistent with the borrower's equilibrium strategy. It must charge that borrower a fee of $n_h^*$, with $n_h^*$ given by (A-2), since the bank then just breaks even.

Now suppose the borrower makes an out-of-equilibrium move and demands an interest factor $\tilde{r} \notin \{r_h^*, n_h^*\}$. We have postulated an out-of-equilibrium belief on the bank's part that such a borrower is of low quality. Thus, the NSF fee the bank will charge such a borrower as a best response to this move is obtained by solving

$$[1 - q]\tilde{r}L + qw_l + [1 - q]\beta_l[\{\tilde{n} - c\} - \gamma\{\tilde{n} - c\}] - R_f L = 0,$$

which yields

$$\tilde{n} = \{R_f L - [1 - q]\tilde{r}L - qw_l\}\{[1 - q]\beta_l[1 - \gamma]\}^{-1} + c. \quad \text{(A-6)}$$

Note now that the contract $\tilde{\psi} = \{\tilde{r}, \tilde{n}\}$ yields the bank zero profit, conditional on its belief that the borrower is low quality. By definition of the first best, such a contract cannot yield any higher utility to the low quality borrower than its equilibrium contract. That is

$$\tilde{r}L + \beta_l\tilde{n} \geq r_l^*L + \beta_l n_l^*.$$

Let $\Psi$ be a family of contracts such that (i) the bank earns zero profit on each contract in the family if it is taken by the high quality borrower and (ii) the low quality borrower does not strictly prefer any contract in $\Psi$ to its equilibrium contract. Then $\psi_h = \{r_h^*, n_h^*\} \in \Psi$. Moreover, it is obvious that if $\tilde{\psi}$ is taken by a high quality borrower, the bank earns *positive* profit. Thus, $\tilde{\psi} \notin \Psi$. Since $\psi_h$ is the cost minimizing member of $\Psi$, it is clear that the high quality borrower prefers $\psi_h$ to $\tilde{\psi}$.

To see that $\partial(n_h^* - n_l^*)/\partial(w_h - w_l) > 0$, note that $n_h^* - n_l^* = q[1 - q]^{-1}[w_h - w_l][\beta_l - \beta_h(1 - \gamma)]^{-1}$ and differentiate. Q.E.D.

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